

Claims

1. An optical wavelength division multiplexer/demultiplexer device comprising a substrate having a plurality of wavelength selecting filters, said filters being arranged to provide conversion between a combined beam comprising a plurality of wavelength channels and a plurality of separate beams each comprising a subset of said plurality of wavelength channels, characterised in that hollow core waveguides are formed in said substrate to guide light between the wavelength selecting filters.
2. A device according to claim 1 wherein each of said plurality of wavelength selecting filters transmit a single wavelength channel.
3. A device according to any preceding claim wherein the wavelength selecting filters comprise thin film optical filters.
4. A device according to any preceding claim wherein the substrate additionally comprises a plurality of alignment slots arranged to receive, in alignment, said optical filters.
5. A device according to claim 4 wherein said alignment slots comprise micro-electro-mechanical system (MEMS) structures to provide said alignment.
6. A device according to any preceding claim wherein the substrate comprises semiconductor material.
7. A device according to claim 6 wherein the semiconductor material is silicon.
8. A device according to claim 7 wherein the substrate comprises silicon on insulator.
9. A device according to any of claims 1 to 5 wherein said substrate comprises a silicon oxide based material.

10. A device according to any preceding claim wherein said hollow core waveguides are formed using micro-fabrication techniques.
11. A device according to claim 10 wherein the micro-fabrication techniques comprise deep reactive ion etching.
12. A device according to any preceding claim wherein a base portion and a lid portion are provided to define said hollow core waveguide.
13. A device according to any preceding claim wherein at least one further hollow core waveguide is provided in the substrate to guide said combined beam and/or said plurality of separate beams each comprising a subset of said plurality of wavelength channels to/from said plurality of wavelength selecting filters.
14. A device according to claim 13 wherein at least one optical fibre alignment slot is provided in said substrate, said optical fibre alignment slot being arranged to receive an optical fibre in alignment thereby enabling light to be coupled between said optical fibre and said at least one further hollow core waveguide.
15. A device according to claims 14 wherein a mode matching means is provided to couple light between the at least one optical fibre and the at least one further hollow core waveguide.
16. A device according to claim 15 wherein the mode matching means comprises any one of a ball or GRIN lens.
17. A device according to any preceding claim wherein at least one of the hollow core waveguides comprise one or more reflective elements.
18. A device according to any preceding claim wherein at least some of the internal surface of the hollow core waveguides carry a reflective coating.

19. A device according to any preceding claim wherein the hollow core waveguides are dimensioned to support fundamental mode propagation.
20. A device according to any one of claims 1 to 18 wherein the hollow core waveguides are dimensioned to support multi-mode propagation.
21. A device according to claim 20 wherein said wavelength selecting filters are spaced apart by the re-imaging distance.
22. A device according to any preceding claim wherein said hollow core waveguides have a substantially rectangular cross section.
23. A device according to any preceding claim wherein the combined beam comprises three or more wavelength channels.
24. An optical device comprising a demultiplexer stage comprising a device according to any preceding claim that is arranged to receive a combined beam comprising a plurality of wavelength channels and to separate said combined beam into a plurality of beams each comprising a subset of said plurality of wavelength channels, and a multiplexer stage comprising a device according to any preceding claim that is arranged to receive a plurality of beams each comprising a subset of said plurality of wavelength channels and to combine said plurality of beams to produce a combined beam comprising a plurality of wavelength channels, wherein one or more of the plurality of beams produced by the demultiplexer stage are routed to the multiplexer stage via an optical processing means.
25. A device according to claim 24 wherein the optical processing means comprise at least one optical amplifier.
26. A device according to any one of claims 24 to 25 wherein the optical processing means comprise an optical routing means.

27. A device according to claim 26 wherein one or more additional wavelength channels are received by said optical routing means, said optical routing means being arranged to route at least some of said additional wavelength channels to said multiplexer stage.

28. A device according to any one of claims 26 to 27 wherein the optical routing means comprises a matrix switch.

29. A device according to claim 28 wherein the matrix switch comprises an array of micro-electro-mechanical systems (MEMS) devices.

30. A substrate for an optical wavelength division multiplexer/demultiplexer device comprising a plurality of alignment slots for receiving a plurality of wavelength selecting filters and hollow core waveguides to guide light between said alignment slots wherein the arrangement provides, when appropriate wavelength selecting filters are located in said alignment slots, conversion between a combined beam comprising a plurality of wavelength channels and a plurality of beams comprising a single wavelength channel.

31. A multiplexer/demultiplexer device as substantially hereinbefore described with reference to figures 1 and 2.

32. An add/drop multiplexer device as substantially hereinbefore described with reference to figure 3.